OPERATOR EXPOSURE SURVEY CONSIDERATIONS

REGULATION:
In accordance with the provisions of the regulation for determination of accumulated dose, no licensee or registrant shall possess, use, receive or transfer sources of radiation in such a manner as to cause any individual in a restricted area to receive in any period of one calendar quarter from all sources of radiation a total occupational dose in excess of the standards specified in the following table:

	Rems (Sv) per Calendar Quarter
Whole body; head & trunk; active blood forming organs; lens of eyes; or gonads	1 1/4 (12.5 mSv)
Hands and forearms; Feet and ankles	18 3/4 (187.5 mSv)
Skin of whole body	7 1/2 (75 mSv)

(Assessment of exposure may be done on a monthly basis and if so should not exceed 10 % of the maximum allowable annual exposure in a month)

RATIONALE:
It may be important to determine what occupational workers are receiving from scatter radiation due to their:

1. radiographic workload
2. radiographic techniques, and
3. operator or individual's proximity to radiation sources during radiographic exams.

Typically, this is done by measuring the exposure to which the operator or individual is subjected and assuming a one to one ratio of exposure to dose.

EQUIPMENT REQUIRED
1. Ionization chamber survey rate meter capable of detecting scatter radiation.
2. Appropriate scatter medium or phantom to simulate tissue or object being x-rayed.

MEASUREMENT PROTOCOL
1. Place suitable scatter medium in beam in same position where normally a patient would be positioned for exposure.
2. Operator then positions tube as they would for normal exposure as well as normally used techniques.
3. Collimate generously to maximize scatter and produce conservative results.
4. Evaluate time setting for exposure to accommodate the resolving time of the rate

meter used.
5. Make several exposures and record the average of the readings.
6. The Agency routinely uses 90 kVp, 200 mA and 0.5 seconds producing 100 mAs to determine scatter readings.

CALCULATIONS:

The exposure "D" is the product of the exposure rate "I" of radiation and the exposure time "t" or "D = I x t." The exposure time can be in any units (seconds, minutes, hours, etc.). However, for convenience in calculating the exposure, the exposure rate and time will have to be converted to the same units of time; that is, the exposure rate of radiation will have to be in milliroentgen/second, or minute or hour. For most radiation survey meters, the unit used is milliroentgen/hour
(mR/hr).

Example 1: Given the average working situation of;

1. 150 = number of dental films exposed per week
2. 0.5 seconds (secs) = average x-ray exposure "on time" per film (exposure)
3. 200 mR/hr = exposure rate to the individual or operator from the phantom at their position attributable to scatter radiation

To solve for "D", values for both "I" and "t" are needed, which were given in the above example: I = 200 mR/hr and t = the product of the number of films per week (150) and the average exposure time per film (0.5 seconds)

OR $\frac{150 \text{ films}}{\text{week}} \times \frac{0.5 \text{ seconds}}{\text{film}} = \frac{75 \text{ seconds}}{\text{week}}$

Convert 75 seconds to hours. Since there are 60 seconds/minute X 60 minutes/hour, or 3600 seconds per hour, a total of 75 seconds is 75/3600 hours, or 1/48 hour.

Therefore: D = I x t
D = 200 mR/hr x 1/48 hr/week
D = 4.2 mR/week exposure to individual.

Example 2: Given the average working situation of;

1. 30 = number of films exposed per week
2. 0.5 seconds (secs) = average exposure "on time" per film
3. 30 mR/hr = exposure rate to the individual or operator from the phantom, at their position, attributable to scatter radiation

30 films/wk x 0.5 sec./film = 15 seconds/week

Convert seconds to hours, thus 15/3600 hours, or 1/240 hour.

Or; D = I x t
D = 30mR/hr x 1/240 hr/week
D = 0.125 mR/wk exposure to individual

(100 mRems/wk of exposure to an operator is an assumed maximum level)

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